A HOT-ELECTRON DIRECT DETECTOR FOR RADIOASTRONOMY

B.S. Karasik, W.R. McGrath, and H.G. LeDuc

Center for Space Microelectronics Technology, Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, MS 168-314, Pasadena, CA 91109

phone: (818) 393-4438, fax: (818) 393-4683, E-mail: Boris.Karasik@jpl.nasa.gov

A new approach is proposed to improve the sensitivity of direct-detection bolometers. The idea is to adjust a speed of the thermal relaxation of hot-electrons in a nanometer size normal metal or superconductive transition edge bolometer by controlling the elastic electron mean free path. If the bolometer contacts are made of a superconductor with high critical temperature then the thermal diffusion into the contacts is absent because of the Andreev's reflection and the electron-phonon relaxation is the only mechanism for heat removal. The relaxation rate should behave as T^4l at subkelvin temperatures (l is the electron elastic mean free path) and can be reduced by factor of 10-100 by decreasing l. Then an antenna- or waveguide-coupled bolometer with a time constant ~10^{-3} to 10^{-5} s at $T \approx 0.1$-0.3 K will exhibit photon-noise limited performance in millimeter and submillimeter range. The bolometer will have a figure-of-merit $NEP\sqrt{\tau} \approx 10^{-22}$-$10^{-21}$ W/Hz at 100 mK which is 10^3 times smaller than that of a state-of-the-art bolometer. This will allow for a tremendous increase in speed which will have a significant impact for observational mapping applications. Alternatively, the bolometer could operate at higher temperature with still superior sensitivity

This research was performed by the Center for Space Microelectronics Technology, JPL, California Institute of Technology, under the contract for NASA.

Topic 4: Detectors and Mixers
Oral